CLAIMS

WE CLAIM:

1. An air turbine starter, comprising:

a starter housing adapted to couple to a gearbox assembly, the starter housing including an opening configured to provide fluid communication between the gearbox assembly and the starter housing, wherein at least a portion of the gearbox assembly is at a pressure of P_1 and at least a portion of the starter housing is at a pressure of P_2, thereby generative a pressure force (F_p) therebetween; and

a check valve assembly disposed within the opening, the check valve assembly comprising:

a valve body having an inlet port, an outlet port, and a flow passage therebetween;

a valve seat adjacent the valve body and having an opening therethrough, the valve seat opening in fluid communication with the valve body flow passage; and

a valve element disposed between the valve seat and the valve body, the valve element capable of being acted upon by a gravitational force (F_w), a viscous force of the fluid to be communicated between the gearbox assembly and the starter housing (F_v), a buoyancy force of the valve element (F_b), and the pressure force on the valve element (F_p), the valve element further configured to translate axially to a closed position when $P_2 < P_1$ and $F_w < F_v + F_b + F_p$.

2. The air turbine starter of claim 1, wherein the valve body comprises:

a backing plate;

a cage coupled to the backing plate, wherein at least one portion of the cage extends across the valve body flow passage; and

a protrusion extending from a surface of the at least one portion of the cage configured to selectively contact the valve element.

3. The air turbine starter of claim 2, wherein the protrusion is adjustable between a first and a second position.

4. The air turbine starter of claim 1, wherein the valve element further comprises:

a shell; and

a mass disposed within the shell.

5. The air turbine starter of claim 4, wherein the shell comprises chemically resistant plastic.

6. The air turbine starter of claim 4, wherein the shell comprises low density plastic.

7. The air turbine starter of claim 4, wherein the mass has a density that is greater than the density of the shell.

8. The air turbine starter of claim 1, wherein the valve element has a density that is greater than the density of the fluid to be communicated between the gearbox assembly and the starter housing.

9. The air turbine starter of claim 1, wherein the valve seat further comprises an elastomeric portion coupled thereto and configured to selectively contact the valve element.

10. The air turbine starter of claim 1, wherein the valve seat comprises an elastomeric material.

11. A check valve assembly for placement between a first environment, at least a portion of which is at a first pressure (P_1), and a second environment, at least a portion of which is at a second pressure (P_2), wherein the difference between the first and second pressures generate a pressure force (F_p), the check valve assembly comprising:

a valve body having an inlet port, an outlet port, and a flow passage therebetween;

a valve seat adjacent to the valve body and having an opening therethrough, the valve seat opening in fluid communication with the valve body flow passage; and

a valve element disposed between the valve seat and the valve body, the valve element capable of being acted upon by a gravitational force (F_w), a viscous force of the fluid to be communicated between the gearbox assembly and the starter housing (F_v), a buoyancy force of the valve element (F_b), and the pressure force on the valve element (F_p), the valve element further configured to translate axially to a closed position when $P_2 < P_1$ and $F_w < F_v + F_b + F_p$.

12. The check valve assembly of claim 11, wherein the valve body comprises:

a backing plate;

a cage coupled to the backing plate, wherein at least one portion of the cage extends across the valve body flow passage; and

a protrusion extending from a surface of the at least one portion of the cage configured to selectively contact the valve element.

13. The check valve assembly of claim 12, wherein the protrusion is adjustable between a first and a second position.

14. The check valve assembly of claim 11, wherein the valve element further comprises:

a shell; and

a mass disposed within the shell.

15. The check valve assembly of claim 14, wherein the shell comprises chemically resistant plastic.

16. The check valve assembly of claim 14, wherein the shell comprises low density plastic.

17. The check valve assembly of claim 14, wherein the mass has a density that is greater than the density of the shell.

18. The check valve assembly of claim 11, wherein the valve element has a density that is greater than the density of the fluid to be communicated between the gearbox assembly and the starter housing.

19. The check valve assembly of claim 11, wherein the valve seat further comprises an elastomeric portion coupled thereto and configured to selectively contact the valve element.

20. The check valve assembly of claim 11, wherein the valve seat comprises an elastomeric material.

21. A check valve assembly for placement between a first environment, at least a portion of which is at a first pressure (P_1), and a second environment, at least a portion of which is at a second pressure (P_2), wherein the difference between the first and second pressures generate a pressure force (F_p), the check valve assembly comprising:

a backing plate having an inlet port, an outlet port, and a flow passage extending therebetween;

a cage coupled to the backing plate, at least one portion of the cage extends across the flow passage;

a protrusion extending from a surface of the at least one portion of the cage configured to selectively contact the valve element;

a valve seat adjacent to the cage and having an opening therethrough, the valve seat opening in fluid communication with the valve body flow passage; and

a valve element disposed between the valve seat and the valve body, the valve element capable of being acted upon by a gravitational force (F_w), a viscous force of the fluid to be communicated between the gearbox assembly and the starter housing (F_v), a buoyancy force of the valve element (F_b), and the pressure force on the valve element (F_p), the valve element further configured to translate axially to a closed position when $P_2 < P_1$ and $F_w < F_v + F_b + F_p$.

22. The check valve assembly of claim 21, wherein the protrusion is adjustable between a first and a second position.

23. The check valve assembly of claim 21, wherein the valve element further comprises:

a shell; and

a mass disposed within the mass.

24. The check valve assembly of claim 22, wherein the shell comprises chemically resistant plastic.

25. The check valve assembly of claim 22, wherein the shell comprises low density plastic.

26. The check valve assembly of claim 22, wherein the mass has a density that is greater than the density of the shell.

27. The check valve assembly of claim 21, wherein the valve element has a density that is greater than the density of the fluid to be communicated between the gearbox assembly and the starter housing.

28. The check valve assembly of claim 21, wherein the valve seat further comprises an elastomeric portion coupled thereto and configured to selectively contact the valve element.

29. The check valve assembly of claim 21, wherein the valve seat comprises an elastomeric material.